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Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER & SYSTEMS COMPANIES — WORLDWIDE

MAY 14, 1990



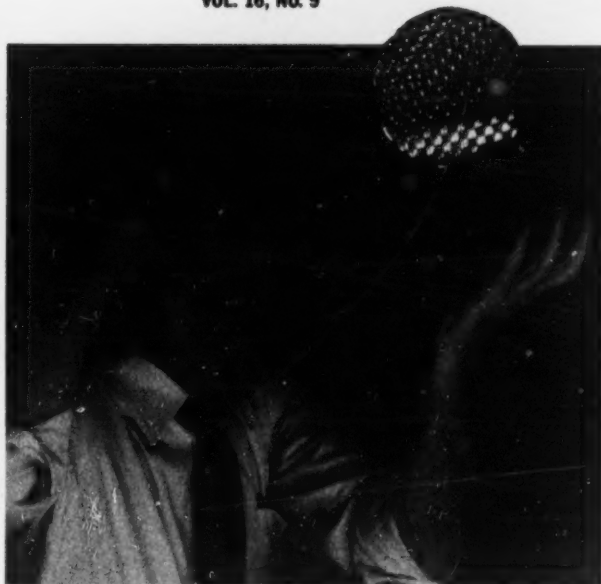
Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES — WORLDWIDE

VOL. 16, NO. 9

MAY 14, 1990

Cover photograph: Christopher Songmann



PAGE 44 Robert Graham, president of Novellus Systems: U.S. equipment makers can roll back falling market share by pushing hard for foreign sales

COVER STORY/SPECIAL REPORT

44 U.S. semi equipment makers reach for smaller market share

New year, same crisis. U.S. vendors of semiconductor manufacturing equipment are still fighting an uphill battle against tough Japanese competition and a shrinking domestic marketplace. But not all the news is bleak. By going where the action is — to Japan and other Pacific Rim countries — companies such as Robert Graham's Novellus Systems were able to post significant gains.

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The unauthorized U.S. circulation of *The Japan That Can Say "No,"* by Sony chairman Akio Morita and conservative politician Shintaro Ishihara has ruffled some American feathers.

SPECIAL REPORT

44 U.S. semi equipment makers must move the earth to survive

Even though the overall value of U.S. IC products grew significantly during the '80s, the tremendous loss of market share is a never-ending source of concern to the domestic semiconductor equipment supplier. Small U.S. equipment suppliers have been particularly affected because they often lack the means to set up and maintain global operations.

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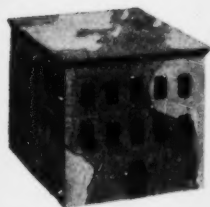
71 Can AST make it into the big leagues — and stay there?

After taking its hits in 1989, the former board-level vendor has rebounded and now is looking to scrap its high-tech, low-profile image and to position itself as a top-tier PC player such as Compaq or even IBM.

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For electronics companies that expect to stay ahead of market changes, there just isn't enough time to wait for new markets to develop before beginning full-run production. Fast-growing drive maker Conner Peripherals' approach to rapidly ramping up new products keeps the company's quality team hopping.



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PAGE 79 Conner Peripherals' quality vice president Simon Ancrì: "You have to keep raising the bar"

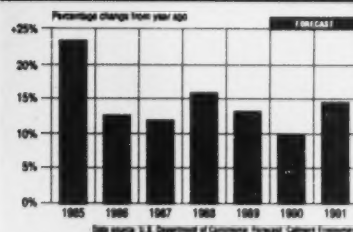


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Amid a chorus of moans from private industry, the Taiwan government has slowly tightened the purse strings on funds for electronics research and development.

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Despite the uncertainty of political events in China over the past year, business apparently takes precedence over politics for the mainland's democratic cousins on the island of Taiwan.

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If you think the "Computer Age" will be dominated by computer-shaped devices, think again. Only a tiny fraction of all CPUs sold worldwide have ended up in computers. The vast majority reside behind-the-scenes in a diverse array of products from microwave ovens to automobiles to guided missiles — capturing the fancy of U.S. semiconductor companies.

109 You don't need a road map to find the growing GIS market

Trying to map new territory? The growing market for geographic information systems is finding its way into a wide range of applications and is providing hardware and software vendors with opportunities. GIS may be the fastest growing segment of the CAD/CAM market.

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115 International directory of plant sites and facilities

Moving to a foreign country is never simple. Different cultures, tax laws and employment conditions can appear to be insurmountable problems. To help you get started, ELECTRONIC BUSINESS presents its annual international directory of plant sites and facilities.

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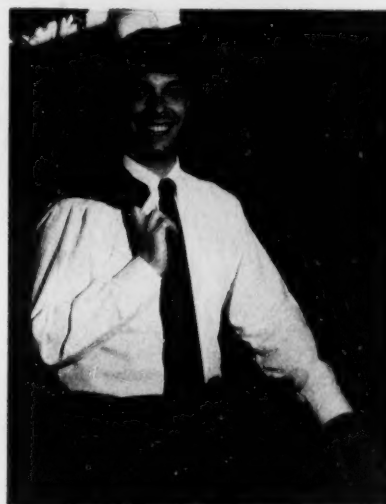
Plant sites: just in case

For several years now ELECTRONIC BUSINESS has published an annual directory of plant sites and facilities. It may not be the most glamorous listing we do, but it always appears like clockwork in the magazine. We publish two plant site directories each year — one on international sites and one on U.S. sites. The 1990 international version is in this issue, and its U.S. counterpart will appear in November.

The listing of plant sites is published as a service to readers. The idea is to supply an initial contact just in case you may be thinking about locating a plant offshore or in another state. One thing is for sure: Count on the directory being neatly tucked away toward the back of the magazine twice a year.

The debatable honor of compiling this year's international directory fell to assistant editor Giuseppe (Joe) Labianca. When he's not putting together directories or creating charts and graphics on the Mac for the rest of us, Joe can be found writing about automotive electronics, passive components and power supplies.

I call the directory a debatable honor because the job requires meticulously calling each country's embassy in the United States and each U.S. state to verify information. Is there a new contact person, address, telephone number? Joe points out that this year's international directory takes on a significantly different flavor. For the first time we are including Eastern European nations and the Soviet Union. With the Berlin Wall gone and the Iron Curtain falling, opportunities to sell electronics to these countries abound. And



Giuseppe Labianca, assistant editor

with the European Community rushing toward a single market, the whole of Europe takes on added importance.

More improvements

We've added an even newer twist to our new "Update" section in the front of the magazine. In this issue, European editor Barbara Berkman presents her first "Letter from London," followed by Japan correspondent Charlie Cohen's "Letter from Tokyo." And finally, turn to page 124 and tell us what you think of this issue. There you'll find our first reader fax poll, something we hope to include on a regular basis to give you a chance for some fast feedback on your likes and dislikes in each issue of the magazine.

MARVIN GREENE, section editor

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VBPA ABP

in Milpitas, Calif. One reason for the activity, Bell says, has been the competitive posture of market newcomer Samsung Electronics Co. Ltd. The South Korean company sold its DRAMs for as much as \$2 below the market price last year but is now selling at the same level of Japanese producers.

Although Bell is cautious about predicting the future, a recent Dataquest Inc. projection forecasts some relief for OEMs. Dataquest estimates that the worldwide DRAM price will drop back to below the \$7 level in this calendar year's second quarter and then stabilize through the end of the year.

Fred Jones, associate director of Dataquest's semiconductor service, says falling prices last year prompted many companies to cut back on their DRAM production last September and October, leading to shortages in January. "Some made production adjustments even in this year's January and February time frame," he says. "So what happens is that production really flattens down and the demand is slightly positive and upturning, momentarily, at least."

XIONG XIAOGE

IC PRODUCTION EQUIPMENT

Will MESA save the small U.S. supplier?

ONE OF THE HOTTEST topics in U.S. semiconductor production equipment circles is the proposed standard known as MESA. Many suppliers believe MESA may be the saving grace for small U.S. equipment manufacturers.

MESA, or Modular Equipment Standards Architecture, is known as a cluster tool or multi-chamber standard because it addresses the relatively recent practice of grouping several chip fabrication process modules around a common robotic handler to speed production and reduce wafer contamination. MESA will specify the capabilities of the robotic platform as well as the interfaces between the platform and the attached process modules.

MESA is intended to serve as an international standard, but many observers believe it will produce disproportionate rewards for U.S.



Linda Sue Scott

Rapro's Wong: MESA raises tricky issues

manufacturers. This boon will materialize, the argument goes, because the U.S. supplier base consists largely of small firms with limited resources. To compete today, these companies must develop entire systems of platforms and attached process modules.

Japanese equipment manufacturers, by contrast, "Have so much available money, they can build totally custom systems," says Robert Graham, president and CEO of Novellus Systems Inc. in San Jose. As a result, he says, it is the strapped U.S. companies that stand to benefit most from MESA.

But the leading U.S. vendor, Applied Materials Inc. of Santa Clara, Calif., while not opposed to MESA, worries that the standard might bypass its installed base of proprietary multi-chamber systems — the Precision 5000 series, says president James Bagley. "It's inconceivable that you would develop a standard that would exclude our base. You would obsolete the only multi-chamber product that is widely accepted today," Bagley says.

Questions of installed base aside, implementing the MESA standard could prove tricky. Fred Wong, vice president of technology at Fremont, Calif.-based Rapro Technology Inc., says it remains unclear who will take responsibility to assemble and support MESA-based systems. Start-up Rapro has introduced a cluster-tool robotic platform, the IPS3, which is meant to support the MESA standard

as it evolves.

In some cases, large vendors like Applied Materials might perform the integration, but this approach raises a thorny issue: Any vendor that assumes "ownership" of the system would require access to proprietary data about all attached process modules, including those of competitors.

— D.D.

EUROPE

Europe grabs more of British PC market

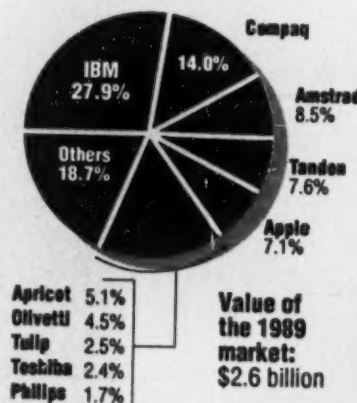
GOOD SHOW, EUROPEAN personal computer vendors: You're moving up in the British market, despite the stranglehold of U.S. vendors.

In Britain, the third-largest European market after Germany and France, N.V. Philips GL has slipped into the ranks of the top 10 suppliers. Meanwhile, Japan's Toshiba Corp. lost more than 1% of its share, while beleaguered British PC-maker Amstrad plc plummeted from 16.7% share in 1989 to 8.5% by the end of January, according to Context Market Research in London. In 1987, Amstrad had as much as one-third of all British PC sales. "It's becoming increasingly difficult for the national suppliers to stay in business," says Context partner Jeremy Davies.

Other PC trends of note: Apple Computer Inc.'s PCs are being

Britain's PC market

Share of market, January 1990



Value of the 1989 market: \$2.6 billion

Source: Context Market Research

viewed more seriously as business machines in Britain, despite "the conservatism of the British," says Davies. Also, sales of Intel Corp.'s 80386-based products accounted for more than 40% of the market in value terms, as opposed to 23% in 1988. Overall, the British PC market grew by 30% to \$2.6 billion in 1989, or 700,000 PCs. Direct sales by OEMs were worth another \$385 million.

BARBARA N. BERKMAN

LASER TECHNOLOGY

Technology is up for grabs — cheap

LITTLE BY LITTLE, industry seems to be getting the message that federally supported labs can be a rich, low-cost source of cutting-edge technology. Case in point: a recent cooperative effort between Sandia National Laboratories in Albuquerque, N.M., and Hampshire Instruments Inc. in Rochester, N.Y.

Under the agreement, Sandia's laser technology will be transferred to Hampshire as part of the company's X-ray lithography R&D. "This is a very capital-intensive business," explains Hampshire marketing manager Jack Chase in Marlborough, Mass. "It could take up to \$100 million to develop a new semiconductor lithography tool. Alliances like these give us a lot of leverage by providing low-cost access to new technology."

At the heart of the arrangement is Sandia's expertise in "injection seeding" of lasers — a technique by which energy from a small laser is amplified by a larger laser to generate a much more powerful pulse of high spectral purity. The laser technology is used to produce an X-ray source used in Hampshire's submicron lithography, according to James Forsyth, the company's vice president of technology.

Chase notes the Sandia agreement is just one element of Hampshire's strategy of digging up and extracting as much technology as possible from the government. "Many government programs now encourage this kind of spinoff," he says, "and that means a lot of very exciting possibilities."

Several recent initiatives — including the National Competitiveness Technology Transfer Act of 1989 — promise to make it easier for future

EUROPE						
Siemens out on Philips' heels in chip sales						
N.Y.-based GE is not the only U.S. company to have a strong presence in Europe. Siemens AG's European sales grew by about 63% in 1989 over 1988, according to West German firm from 1988 to 1989. Philips' 1989 sales in 9.7% drop.						
Overall, North American chip makers companies hold 36.7% of the European market, while the European hold 36.7%, Japan 19.7% and Rest of World 5.9%.						
The total European merchant chip market grew by 14.3% in 1989 over 1988.						
GIUSEPPE LAMIANCA						
Top semiconductor companies in Europe						
Rank	Rank	Company	Sales (\$ millions)		Change	1989 market share
'89	'88		1989	1988		
1	1	Philips	\$967	\$1,018	-5.0%	10.0%
2	5	Siemens	938	569	+64.9%	9.7%
3	2	SGS-Thomson	751	652	+15.2%	7.7%
4	4	Motorola	658	616	+6.8%	6.8%
5	3	Texas Instruments	650	647	+0.5%	6.7%
6	6	Intel	540	485	+11.3%	5.6%
7	8	NEC	420	387	+8.5%	4.3%
8	7	Toshiba	414	390	+6.2%	4.3%
9	9	National Semiconductor	381	386	-1.3%	3.9%
10	11	Hitachi	289	246	+17.5%	3.0%

cooperation between government and industry. According to a report prepared for Rep. Ron Wyden (D-Ore.), the U.S. government spends about \$60 billion a year on its network of 700 laboratories.

H. GARRETT DeYOUNG

CAD/CAM

Computervision rising from Prime's ashes

AFTER PRIME COMPUTER Inc. acquired Computervision Corp. in January 1988, the CAD/CAM vendor all but disappeared from sight. But now it seems CV is rising from the ashes. CV's rebirth follows on the heels of Prime's agreeing to be taken private last year by the J.H. Whitney & Co. venture capital firm.

Under its new owners Prime has been divided into three business units: Computervision (CAD/CAM), minicomputers and service, with each accounting for about one-third of Prime's \$1.8 billion revenue. Com-

putervision president Robert A. Fischer acknowledges that CV is enjoying a greater degree of independence since the Whitney buyout. He even has indicated that in order to recoup its investment, Whitney may consider spinning CV off and taking it public some time in the future.

Other hints of CV's rebirth abound. In March Fischer disclosed that CV's premier software product, CADDs, will be ported to non-Prime computer hardware. And CV's press releases, once printed on Prime letterhead, now appear with the distinctive CV logo with "A Prime Company" printed beneath.

The major reason for CV's independence is that the CAD/CAM business is growing (Fischer estimates CV sales will increase by 13% this year), while Prime's minicomputer business has been shrinking. Although Prime has slashed expenses and cut 2,500 employees from its payroll over the last year, all of that has come from the minicomputer side of Prime's business while spending on the CV side has been increasing.

RICK WHITING

U.S. semi equipment makers must move the earth to survive

Can international marketing operations save U.S. equipment vendors from a shrinking domestic customer base and Japanese competition? For the strongest — maybe

New year, same crisis. U.S. vendors of semiconductor manufacturing equipment are still fighting an uphill battle against tough Japanese competition and a shrinking domestic marketplace. Not all the news is bleak, however, as a variety of American suppliers were able to post significant gains in the year just past.

Most firms that managed healthy growth in 1989 did so by redoubling their international marketing efforts, especially in Japan and other Pacific Rim countries. But this strategy of going where the action is has its limits. Small equipment suppliers — of which the United States has many — often lack the means to set up and maintain global operations. And even the larger U.S. firms will have trouble maintaining their international activities as domestic semiconductor manufacturing continues to wither.

The semiconductor production numbers are less than encouraging for makers of equipment used to fabricate chips. In 1980, North American companies (merchant and captive) accounted for \$9.1 billion, or 75% of the world's total \$12.2 billion in integrated circuit production, while Japanese semiconductor manufacturers produced \$2.3 billion, or 19%, of the total, according to Integrated Circuit Engineering Corp. (ICE). In 1989, ICE esti-

mates, the total IC market reached \$52.9 billion. Japanese production accounted for \$23.2 billion, or 44%, of that total, while U.S. semiconductor production last year was valued at \$22.3 billion, a 42% share.

Backing away from expansion

Even though the overall value of U.S. IC products grew significantly during the 1980's, the tremendous loss of market share is a never-ending source of concern to domestic semiconductor equipment suppliers. "In the U.S., our customers have simply backed away from a strong expansion of their fabrication facilities," says Robert F. Graham, president and

CEO of Novellus Systems Inc.

Nevertheless, Novellus, a San Jose-based manufacturer of chemical vapor deposition (CVD) systems, saw its revenue grow by 120% between 1988 and 1989, from \$23.2 million to \$51 million. Much of this growth came from international sales, which accounted for about 35% of total 1989 revenue, according to Graham. And that trend is continuing, he says.

"In 1989, about 15% of our sales went to Japan. During the first quarter of fiscal 1990, about 35% to 40% of our shipments went to that market," Graham says.

Despite the success of Novellus and several other U.S. companies in broaching the Japanese market, the declining U.S. share of world semiconductor production hurts U.S. equipment suppliers for an obvious reason: each country's chip manufacturers tend to buy their production equipment from domestic suppliers. "In wafer fabrication equipment, Japanese semiconductor manufacturers import just 20% to 25% of their equipment, and U.S. manufacturers import a similar percentage," says Joe Grenier, director of Dataquest Inc.'s Semiconductor Equipment and Materials Service.

For its part, the worldwide semiconductor equipment market totaled \$9.4 billion in 1989, according to VLSI Research Inc. president G. Dan Hutche-

BY DWIGHT B. DAVIS

The top 10

Rank '89	Rank '88	Worldwide calendar year 1989 semiconductor production equipment sales (\$ millions)	
1	2	Tokyo Electron	\$633.9
2	1	Nikon	\$582.2
3	4	Applied Materials	\$523.3
4	3	Advantest	\$398.8
5	6	Canon	\$383.6
6	5	General Signal	\$353.7
7	7	Varian	\$335.0
8	11	Nitachi	\$210.0
9	9	Teradyne	\$199.9
10	13	ASM	\$186.8

Source: VLSI Research Inc.

son. Of the total, Japanese customers accounted for nearly \$3.9 billion, the U.S. for \$3.6 billion, and the rest of the world for \$2 billion.

Even so, U.S. equipment vendors still hold a lead over their Japanese counterparts, producing \$4.4 billion of worldwide shipments last year. The Japanese suppliers accounted for \$4 billion, U.S./Japan joint ventures sold \$300 million, and the rest of the world's manufacturers sold \$800 million worth of equipment.

But Japanese semiconductor producers continue to take market share from U.S. chip vendors, and equipment manufacturers such as Nikon Corp., Canon Inc. and Toyko Electron Ltd. stand to reap the benefits. U.S. suppliers, meanwhile, face the daunting prospect of prying open the tight bonds between Japanese manufacturers and their local suppliers.

Few U.S. companies of any type have met this challenge as well as

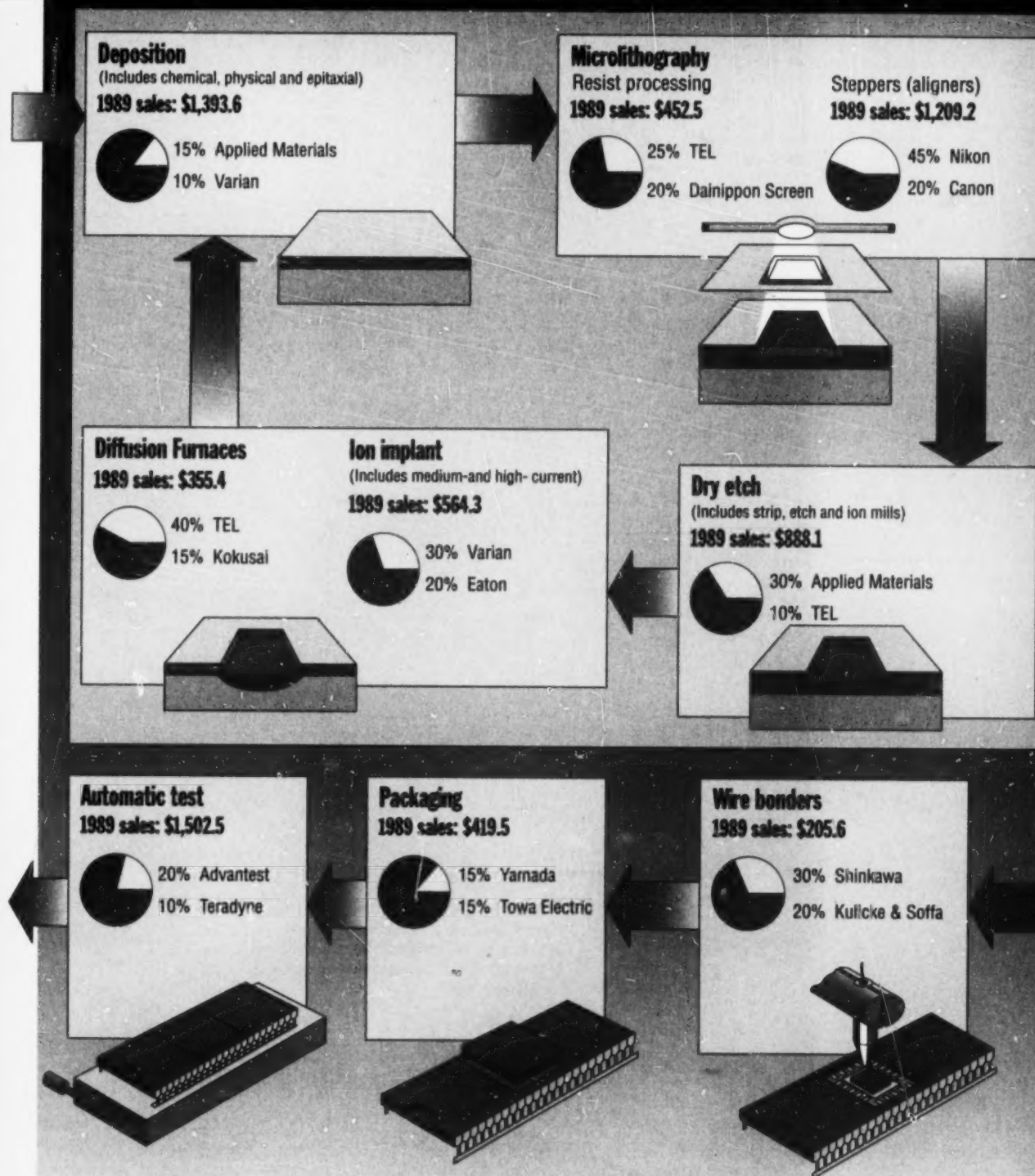


**Robert Graham of Novellus Systems:
U.S. equipment makers can roll back
falling market share by pushing hard
for foreign sales**

Christopher Springmann

Semiconductor manufacturing and inspection equipment

Worldwide calendar year 1989 sales (\$ millions) and leading vendors' market share*

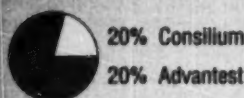


* This chart shows only the major fabrication, test and assembly steps. Their markets do not add up to the total worldwide shipments. Market shares are rounded to the nearest 5%.

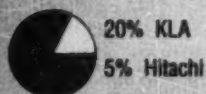
SPECIAL REPORT

SEMICONDUCTOR PRODUCTION EQUIPMENT

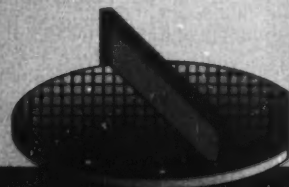
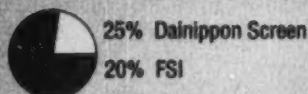
CIM software 1989 sales: \$76.4



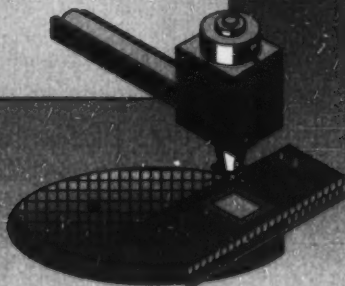
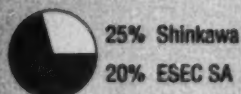
Process diagnostics 1989 sales: \$712.0



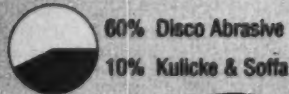
Wafer cleaning systems 1989 sales: \$194.9



Die bonders 1989 sales: \$92.5



Dicing saws 1989 sales: \$83.7



Source: VLSI Research Inc.

Applied Materials Inc. of Santa Clara, Calif., the world's leading vendor of deposition and dry etch equipment. More than a decade ago the company established a wholly owned subsidiary in Japan, and continued to cultivate this operation through the boom and bust years of the '80s.

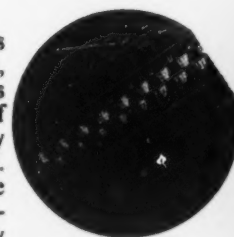
That strategy has paid off handsomely. In fiscal 1989, Applied Materials Japan (AMJ) contributed \$200.1 million to the corporation's \$501.8 million total revenue. U.S. sales that year totaled \$174.8 million, European sales were \$74.6 million, and non-Japan Asian/Pacific sales were \$52.4 million.

Because of AMJ's long-standing presence on the Japanese scene and its sensitivity to local business practices, "We are considered to be a Japanese company by the Japanese," according to James W. Bagley, president and chief operating officer of Applied Materials. In past years Japanese semiconductor manufacturers rarely considered purchasing equipment from offshore suppliers, but Bagley says that practice has changed.

"Today, the Japanese will buy from whatever company provides them with the best products as well as good service and support," he says. "Logistically, of course, that favors domestic suppliers."

Most U.S. equipment manufacturers recognize the importance of establishing a Japanese presence, but gaining such a foothold is a difficult and costly proposition. Kulicke and Soffa Industries Inc. of Willow Grove, Pa., has about 75% of its products installed overseas, according to chairman and CEO C. Scott Kulicke. But only about 5% of the company's sales are in Japan, even though K&S established a sales and service office there 10 years ago.

The company's product line includes wire bondering equipment that is used in the back-end assembly process — a market dominated in Japan by the Tokyo-based Shinkawa Ltd. "Shinkawa owns about 90% of the wire bonder market within Japan, while K&S dominates in the rest of the world," according to New York investment banker R.H.



SPECIAL REPORT

SEMICONDUCTOR PRODUCTION EQUIPMENT



"If you don't have good processing technology, you don't even get to the bargaining table"

James Bagley, Applied Materials

Damon & Co. Inc.

K&S now has "a full-court press in Japan, and we will be successful there at Shinkawa's expense," believes Kulicke. But the price to even be in the game in Japan at this point has been steep.

"Our cumulative losses in Japan are running at about \$35 million, and we're still losing money," Kulicke acknowledges, "but we hope to turn the corner next year." K&S's net sales in 1989, reached \$96.5 million.

Faced with the prospect of such high costs, some U.S. equipment makers have pursued different strategies to gain access to Japanese markets. Ion implant leader Varian Associates Inc., for example, several years ago formed a joint venture with Toyko Electron Ltd. (TEL) to manufacture and market certain Varian products in Japan. In return, Palo Alto, Calif.-based Varian sells and services TEL's line of diffusion furnaces in the United States and Europe. The companies have announced plans to form another joint venture to manufacture some TEL equipment in the United States.

"TEL is a strong, established company in Japan, and is extremely customer oriented," notes Richard Levy, president of Varian's Semiconductor Equipment Group. In addition, he says, the TEL and Varian product lines are complimentary, which often results in sales of both companies' equipment to the same customers.

Varian's semiconductor equipment sales in fiscal 1989 grew to \$321 million, up from \$210 million in 1988. TEL's resales of equipment in Japan accounted for a significant portion of the total shipments, Levy says, but declines to specify the exact amount.

"The single most important factor

for success in the semiconductor equipment industry is the ability to sell in Asia," concludes

Steve Jensen, Varian's vice president of marketing for semiconductor equipment. He notes that Varian also holds majority ownership

in a Korean manufacturing and sales operation, and claims the company holds an 85% share of its product sectors in that fast-growing market.

Maintaining global operations — even in the relatively open markets of Europe, Korea and Taiwan — is a tall order for the smaller U.S. equipment manufacturers. Many have managed to survive by focusing on technologies such as CVD, ion im-



"Our cumulative losses in Japan are running at about \$35 million, and we're still losing money"

C. Scott Kulicke,
Kulicke and Soffa Industries

plant and dry etch.

U.S. firms are the recognized leaders in these areas, and even Japanese manufacturers have been willing to shop overseas for the best available technology. These market sectors have the additional attraction of requiring less research and development expenditures than the Japanese-dominated microlithography/stepper sector, where new product development can easily run \$100 million to \$200 million.

If the R&D costs are manageable, small companies may even have some advantage over their larger competitors. "Small companies are the likely winner if the technology is exploding," says Novellus' Graham. "Large companies

have difficulty focusing their resources."

While technological excellence remains a critical factor in the purchasing equation, however, semiconductor manufacturers are placing increasing weight on other variables. "Today the assumption is, if you don't have good processing technology, you don't even get to the bargaining table," says Bagley of Applied Materials.

Given the "table stakes" of technology, he says, the next two most important issues are equipment reliability and the ability to service and support each customer's requests. Varian's Levy agrees, saying, "The winners will be those companies that do the best job of supporting their customers."

That is where the problems arise for many U.S. equipment makers. Even if a small U.S. firm has technically superior products, it often does not have the resources to mount international support operations. Such companies may be acquired or simply lost in the shuffle as the U.S. semiconductor marketplace — that which the suppliers can most easily service — continues to shrink.

The decline of the domestic market hurts the smaller suppliers first, but even major U.S. players such as Applied Materials, Varian and General Signal Corp. stand to suffer from the trend as well. "Because of our international operations, we're better positioned than some to weather short-term declines in the domestic market," says Bagley, "but if the U.S. decline continues, we'll be hurting."

Elliott Philofsky, CEO of Tegal Corp., a Petaluma, Calif., manufac-



"The winners will be those companies that do the best job of supporting their customers"

Richard Levy, Varian Associates

SPECIAL REPORT

SEMICONDUCTOR PRODUCTION EQUIPMENT

turer of plasma etch equipment, is relying on the company's international business as a buffer against the U.S. slide. Of Tegal's \$60 million revenue in 1989, about half came from international sales. "We project that within five years, 70% to 75% of our sales will be international," he says.

As a result, "We're fairly comfortable with our ability to survive, even if the U.S. semiconductor production goes down," says Philofsky. "But the lack of investment in U.S. fabrication facilities is very alarming to me."

Kulicke of K&S says, "We all want to say [the decline of the U.S. semiconductor industry] is a horrible problem, but it is not going to get us. But

you have to ask, even if the U.S. maintains its current production level, at what point does the domestic market get low enough that it can't support the required level of our R&D?"

Europe's concerns

The concern about the U.S. market isn't limited to domestic equipment vendors. European suppliers as well decry the production shift from the United States to Japan, since the relatively open U.S. market is much easier for them to penetrate.

"Approximately 60% of our 1989 sales were in the U.S., 20% in Europe and 20% in Asia, excluding Japan," according to Richard A. Aurelio,

president of ASM Lithography Inc. in Tempe, Ariz. The world's third largest supplier of microlithographic steppers, according to Aurelio, ASM Lithography, is jointly owned by N.V. Philips GL and NMB, a Netherlands bank.

With Nikon and Canon dividing the Japanese stepper market between them, "It is not in our best interests, politically or practically, to go after the Japanese market yet," Aurelio says. Meanwhile, ASM Lithography was the No. 1 supplier in Europe and in Taiwan last year, and the No. 2 supplier in the United States, behind Nikon.

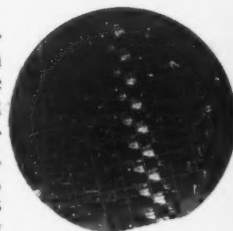
With the company's strong dependence on the U.S. marketplace, "The continued decline of the market is one of the most depressing trends I face," Aurelio says. He believes the reason for this decline is the attitude of U.S. semiconductor managers. "The willingness of these managers to take risks is inversely proportional to the size of their companies. Calculated risks are a necessary part of succeeding in the semiconductor marketplace."

Despite the gloomy U.S. picture, several trends are working to the advantage of the embattled domestic suppliers. One is the continued worldwide growth of the semiconductor marketplace. By 1994, IC sales will reach \$82.9 billion, predicts ICE. That year, the global semiconductor equipment marketplace will reach \$16.2 billion, notes VLSI Research.

At the same time, the increased complexity of ICs is requiring more sophisticated, and higher margin, production and assembly equipment. In 1989, the ion implant sector was growing at about a 50% annual rate, says Varian's Jensen, in large part because CMOS circuits that once required only three or four implants per wafer now require 10 to 13.

As a result, says group president Levy, "We're very optimistic about this business, which is the most dynamic operation within Varian."

Bagley at Applied Materials concurs, saying, "It's still a great industry to be in. It's challenging and it keeps your interest." Still an open question is how many of the smaller domestic suppliers will survive to rise to the challenge. □



The ups and downs of consolidation

Many of the U.S. semiconductor equipment vendors who operated as independent firms in the early '80s did not make it unscathed to the '90s. According to a report published late last year by VLSI Research Inc., 66 industry consolidations have occurred since 1983, 19 companies have either gone out of business or exited the equipment industry, and another 24 are "missing in action," with phones disconnected and no forwarding number.

And consolidation will continue, argues Anthony R. Muller, vice president of finance and CFO at Silicon Valley Group Inc., a San Jose equipment manufacturer. "Our customers can't afford to deal with a large number of small suppliers anymore," he says.

SVG achieved 1989 revenue of \$131 million, and Muller says any equipment company smaller than \$100 million today is "suspect" in the minds of customers. In a short while, he predicts, companies in this marketplace will have to reach revenue of \$250 million in order to feel secure.

Key acquisition

While Muller acknowledges that many acquisitions have soured, he says of the failures: "When you merge dogs, you end up with a kennel." SVG, by contrast, pulled off something of a coup when it acquired Thermco Systems Inc. early in the 1989 fiscal year.

In 1988, SVG's revenue was \$49 million, while Thermco's totaled close to \$70 million. SVG paid cash and extended its credit lines to pay \$20.5 million for the larger company. "We borrowed about \$12 million," says Muller, "but by the end of fiscal 1989 we had paid off all our debt and had \$11 million in cash."

Of late, SVG is widely reported to be after even bigger fish — the microlithography division of former market leader Perkin-Elmer Corp. Reportedly, both IBM — a Perkin-Elmer customer — and the Sematech industry consortium would chip in to help SVG acquire the Perkin-Elmer operation and complete development of its next-generation Micrascan stepper.

None of the parties would comment on the existence or the state of any negotiations. All Muller would say is, "Micrascan looks as though it could be a great technology."

Meanwhile, in mid-March, another Perkin-Elmer equipment operation — the Electron Beam Technology Division — was sold to ETEC Inc., a newly formed Nevada corporation founded by the division's former managers. Several investors, including IBM, Dupont, Grumman Corp., Micron Technology Inc., and Zitel Corp., have taken equity positions in the new company. Also, IBM will license its own advanced electron beam technology to ETEC. □

Socket Wars: IC makers slug it out over embedded control

CPU suppliers who once had eyes only for computers are waging an expensive, high-profile battle for emerging, high-end controller markets

BY PETER BURROWS

If you think the "Computer Age" will be dominated by computer-shaped devices, think again. Only a tiny fraction of all central processing units (CPUs) sold worldwide have ended up in PCs, workstations and other forms of computers. The vast majority reside behind-the-scenes in a diverse array of products from microwave ovens to automobiles to guided missiles.

These hidden CPUs make up the world of "embedded control," and emerging markets for high-end 16- and 32-bit devices have captured the attention of U.S. semiconductor companies that used to have eyes for computers only. This new-found awareness has ignited a marketing war reminiscent of higher-profile electronics industries, and the upshot — increased exposure, applications and customer expectations — has accelerated the growth curve for 16- and 32-bit embedded control markets.

The \$2.9 billion 1988 market for these products — including the more mature 4- and 8-bit controllers — is expected to grow to \$6.8 billion by 1995, according to the Market Intelligence Research Co. (MIRC) of Mountain View, Calif. While the lower tech 4- and 8-bit segments are dominated primarily by Japanese competitors, most of this growth will come at the U.S.-heavy high end;

while 16- and 32-bit products accounted for only 10.9% of embedded control revenues in 1989, MIRC expects them to represent 40.3% by 1995.

"Microprocessor vendors have finally recognized that there are far more sockets for embedded control than there are for general-purpose chips," says Nathan Brookwood, director of strategic marketing for Intergraph Corp. in Palo Alto, Calif. The rule of thumb states that four embedded chips are sold with each computer CPU to drive peripherals such as disk drives and laser printers, and that doesn't count the hordes that reside in products such as appliances and automobiles that are not linked directly to computers.

"We used to be sort of quiet from an exposure standpoint," notes Stephen Marsh, director of marketing for microcontrollers at Motorola Inc. in Austin, Texas. "Much of the market was focused on low-end devices, and our customers simply bought our relatively simple products and used them in their own products. But now it turns out customers are using those products to do more complex things.

You can't just pop [the products] in and watch them work anymore."

Customer demands

Maybe not, but don't tell that to users of embedded CPUs. While product complexity is skyrocketing, so are customer demands for easy-to-use answers to their manufacturing needs. "Customers expect a much more complete solution, from development tools to high-performance designs that can be put right into production," says John Leediker, marketing director at Intel Corp.'s Chandler, Ariz., Microcomputer/ASIC division. "The customer demands much more than a hunk of silicon," adds Intel spokeswoman Sara Killingsworth. "There was a time that you could just throw a design out there and the market was so hungry for technology that they would just bite the hook. But no more."

Some feel there are simply too many hooks in the water. Competition has always been fierce at the 4- and 8-bit level. The relatively slow developing 16-bit market, which MIRC expects to grow 22.5% per year through 1995, still counts only a handful of commercial competitors, including Intel, Motorola, Harris

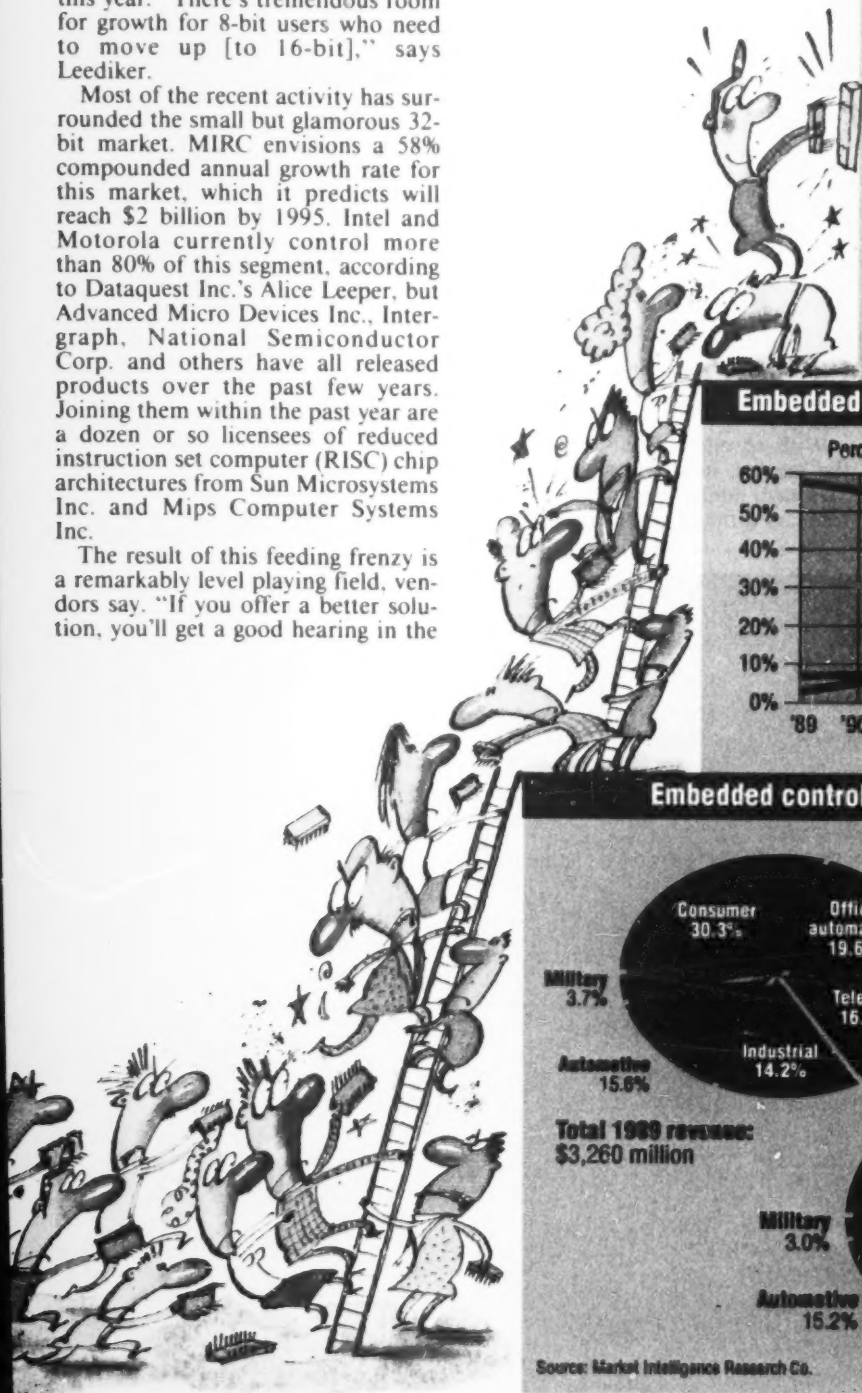


Hal Mayforth

Corp., NEC and Texas Instruments Inc. However, market leader Intel claims this segment will be jump-started when almost 2,500 design wins it obtained in a 1987-88 embedded control push go into production this year. "There's tremendous room for growth for 8-bit users who need to move up [to 16-bit]," says Leediker.

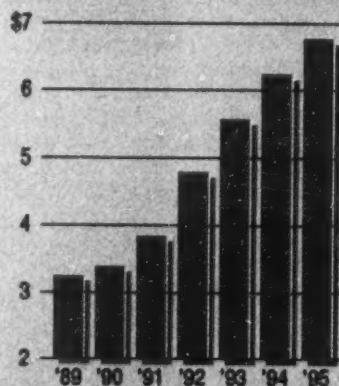
Most of the recent activity has surrounded the small but glamorous 32-bit market. MIRC envisions a 58% compounded annual growth rate for this market, which it predicts will reach \$2 billion by 1995. Intel and Motorola currently control more than 80% of this segment, according to Dataquest Inc.'s Alice Leeper, but Advanced Micro Devices Inc., Intergraph, National Semiconductor Corp. and others have all released products over the past few years. Joining them within the past year are a dozen or so licensees of reduced instruction set computer (RISC) chip architectures from Sun Microsystems Inc. and Mips Computer Systems Inc.

The result of this feeding frenzy is a remarkably level playing field, vendors say. "If you offer a better solution, you'll get a good hearing in the



Total embedded market

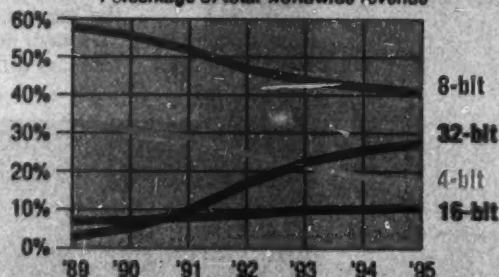
Worldwide revenue (\$ billions)



Source: Market Intelligence Research Co.

Embedded control market by technology

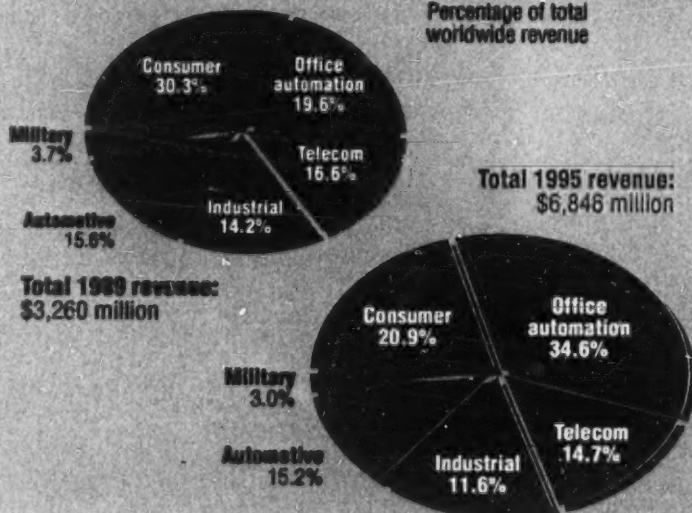
Percentage of total worldwide revenue



Source: Market Intelligence Research Co.

Embedded control market by application

Percentage of total worldwide revenue



Source: Market Intelligence Research Co.

SEMICONDUCTORS

all have dreams of being workstation vendors, but they're being forced to look for other markets," says Robert G. Kirk, president of Microtec Research Inc., a Santa Clara, Calif.-based software development tools vendor.

In many ways, this strategy is a relatively safe bet, observers say. The structure of the embedded market offers protection from the winner-take-all environment that Intel cultivated in the PC market. Unlike the market for general-purpose machines, the embedded marketplace is highly segmented, leaving room for vendors to specialize in vertical markets such as the automotive or communications industries. This makes all-encompassing standards unlikely and reduces the chance that one vendor will monopolize the attention of third-party software vendors, as Intel did with the IBM PC.

"On the embedded side, people don't care how many third-party software vendors you have lined up, because they're going to write their own code anyway," says Intergraph's Brookwood. "You're only as good as your price/performance and the ease with which your customers can use your chips in their products."

Many of the recent 32-bit embedded control offerings are actually microprocessors that were originally designed as computer CPUs. This includes products from AMD, Intel, Intergraph and National, as well as the licensees of RISC architectures from Sun and Mips.

Sun has been especially aggressive in signing up licensees to tailor its Sparc architecture more specifically for embedded control. The company recently signed up N.V. Philips GL's Electronic Components Group, for example, in an effort to build on that company's strength in consumer electronics, even though Philips had not previously offered a RISC-based product. Others have made varying degrees of changes to their basic designs, with many later generation models highly optimized for embedded applications.

Repositioning a ploy?

Veterans of the embedded control market criticize this crude repositioning as simply trying to eke value out of products that failed in the computer business. "They're throwing these microprocessors at the em-

Despite 32-bit hoopla, it's an 8-bit world

The arrival of high-powered newcomers to the embedded control market has dominated business and technical news pages, but the less trendy 4-bit and 8-bit market segments are still where the money is.

More than 1.1 billion of these devices were sold in 1989, for sales totaling in excess of \$2.9 billion, says Market Intelligence Research Group (MIRC): the 8-bit segment accounted for 59% of the market; the 4-bit another 31%. "Glamour always surrounds 32-bit, no matter what it is," says Will Strauss of the Tempe, Ariz.-based firm Forward Concepts Co., "but the real war is being fought at the 4- and 8-bit levels. They're what pay the bills."

At least 26 competitors currently compete in these still growing lower-end markets, says

Strauss. MIRC forecasts 7.2% revenue growth and 14% shipment growth for the 8-bit segment market between 1986 and 1995, powered by expanding and emerging applications in automobiles, telecommunications and consumer electronics.

"It's still an 8-bit world, and it probably will be until the next century," says Strauss.

The more mature 4-bit market, the lair of Japan's consumer electronics giants, will experience slowing revenue growth through the early 1990s as commodity prices sink farther below the \$1-per-device level, and as manufacturers find ways to move up to 8-bit technology efficiently. Still, MIRC expects shipments to grow from 997.6 million units in 1990 to 1.2 billion by the year 1995. □

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MARKET PERSPECTIVES

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bedded marketplace, even though we've seen the huge difference between their success and the success of microcontrollers," says Motorola's Marsh.

Dataquest estimates that microcontrollers, which are fully-integrated "systems on a chip," made up 94% of all embedded device sales in 1989. Microprocessors, which are typically far more expensive, are less integrated CPUs that require a set of peripheral chips to provide functions such as memory, input/output interface and timing.

"Intel started banging the drum about using microprocessors for embedded control and targeted all the noise at the high-end," says Marsh. "It's to their advantage to confuse embedded controllers with microprocessors, because they don't have a 32-bit microcontroller. But we take a radically different approach. We think embedded control markets are far too cost sensitive for microprocessors." Motorola's 32-bit microcontroller, the first to be announced,

costs around \$57; Intel's 32-bit 80960KB microprocessor costs around \$127.

Shmuel Halevi, a vice president at Boston-based The Technology Research Group, disagrees. He argues that the microprocessor's time has truly come. "Repositioning is not a ploy," he says. "It's a valid trend. It used to be that general-purpose chips weren't strong enough for embedded applications, but now there's more than enough power for most customers." Adds AMD's Peskuric: "A lot of our designs come at the expense of Motorola's 68020 microcontroller, which gives you 2 or 3 MIPS for \$60 a piece. You get 9 MIPS for \$68 with our microprocessor."

Flooding market

Some say that the RISC microprocessors flooding to market offer too much power and question their suitability for embedded control. These devices undoubtedly offer significant performance benefits; a graphics board introduced by AMD for the

Apple Computer Corp.'s Laser Writer II in March will speed up printer performance by two to five times, claims Peskuric. But, as Russell K. Johnsen, imaging group director at National, asks, "Why do you need a high-performance microprocessor if you only have a four-page a minute printer. You don't want to shoehorn a high-priced CPU into a cost sensitive system."

The debate surrounding embedded RISC technology will not be settled for years to come, observers say, but most agree this technology will dominate highly sophisticated data-intensive applications such as navigation control and machine vision. The question is whether RISC's higher prices and the added software development they require will fall far enough to make them viable for high-volume, cost-sensitive applications.

Armando Viteri, Sun's Sparc marketing group manager, argues that history is on Sun's side. "First you capture the systems market, and the embedded side will follow," he says. "That's what happened with Intel and Motorola. It's just a matter of time." Sun is counting on licensees like Philips, Fujitsu and LSI Logic Inc. to find ways to bring down the uncompetitive price of RISC-based embedded devices.

It will be years before RISC's impact on embedded control is clear, but tremendous markets certainly await the winners of the 32-bit marketing war. The 58% compounded annual growth predicted by market watcher MIRC will be driven primarily by high-volume markets in office automation such as laser printers, as well as telecommunications and automotive electronics.

But analysts fear that the upper echelon of the embedded control market is overcrowded — especially the 32-bit segment. "The high-end market is not that mature," says Leeper. "There's a lot of people scrambling for sockets that don't even exist yet." She and others do not envision appreciable profits in the short term and predict a shake-out within two to three years. The new, high-profile attention to marketing could also prove to be a burden.

"It's not even the cost of design that drags them down," she says. "It's just that the cost of promoting a new processor line is staggering." □

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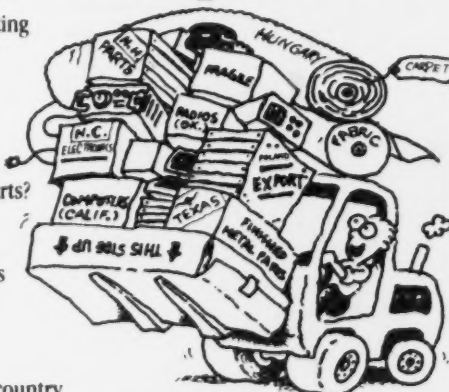
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You don't need a road map to find the growing GIS market

Trying to map new territory? Geographic information systems represent a growing commercial market for new CAD/CAM technology

En route to a fire, a fire engine receives a detailed map via a portable fax from the department's geographic information system (GIS). The map shows details of a burning building, the layout of surrounding streets, the location of water supplies and other crucial data.

This is no futuristic fantasy. GIS is already finding its way into a wide range of applications and is providing hardware and software vendors with opportunities in what may be the fastest growing segment of the CAD/CAM market.

Defining GIS is not easy. However, Daratech Inc., a Cambridge, Mass., market research firm, proposes a simple but all encompassing definition: geographic information systems are used to capture, manage, analyze and display geographic information.

Environmental monitoring, site planning and natural resource management have been traditional GIS applications. Utility and transportation firms are increasingly turning to GIS for facilities planning and management tasks while federal, state and local governments are using geographic information systems to manage public resources, according to Daratech. GIS is even finding its way into such commercial applications as demographic market analysis.

The city of Seattle, for example, recently awarded Tektronix Inc. a \$350,000 contract for XD88 graphics workstations and servers running Arc/Info software from Environmental Systems Research Institute (ESRI) Inc. to build a database of the city's topography and facilities. The French Industrie Geographic Nationale, France's equivalent of the U.S. Geologic Survey, purchased Computervision GIS products valued at \$1.9 million to create a three-dimensional map of France. Great North-

ern Nekoosa Corp. uses Intergraph Corp. geographic information systems to help manage its 2.1 million acres of Maine forest land.

Healthy growth projected

In a report on the GIS market, Daratech estimates that worldwide GIS software sales reached \$203.7 million in 1989, up 32% from \$154 million in sales the previous year. The report projects that sales of GIS software will grow at an annual pace of 35% to 40% through 1993.

Daratech also calculates that combined worldwide sales of computer hardware, software and services in the GIS market reached \$621 million in 1989 and will show a compound annual growth rate of 32% over the next several years.

"The opportunities are great because no one has an overwhelming part of [the market]," says Steven M. Fisch, vice president and general manager of GIS at Prime Computer Inc.'s Computervision subsidiary in Bedford, Mass. "The market itself has so many niches that it's hard for any one vendor to cover them all,"

BY RICK WHITING



Douglas Gerull, Intergraph vice president: Linking advanced technology with geographic databases is the industry's biggest challenge

MARKET PERSPECTIVES

CAD/CAM

agrees Robin Brown, GIS industry analyst at Daratech.

The size of the GIS market and the complexity of GIS applications are escalating in light of recent industry trends: decreasing computer hardware prices, improvements in data storage and networking technology, and rapid growth in the amount and variety of geographic information.

Fisch says that ease-of-use is critical. Unlike most CAD/CAM applications that are largely used by engineers, geographic information systems are primarily used by social service and government professionals such as environmental planners and property tax assessors.

Because GIS involves storing, processing and displaying graphic images and large amounts of data, raw compute power and the capacity to store huge databases are necessary. RISC microprocessor technology, optical disk storage and database management systems are all boosting growth within the GIS market. Improvements in scanners and digitizers that turn photos and maps into computer-stored data and high-quality output devices such as plotters and laser printers are adding fuel to that growth.

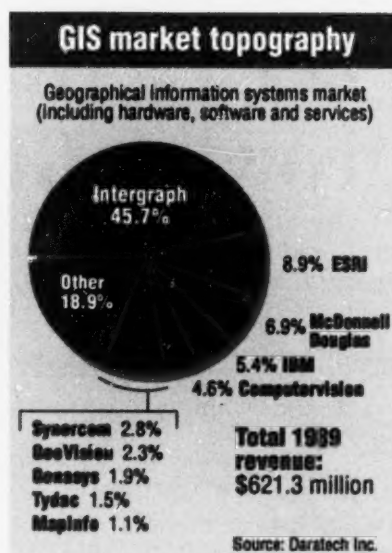
Daratech's Brown says the growing availability of data from public and private sources — demographic information and boundary data from governments, aerial photography, and satellite reconnaissance — are creating the need for GIS products.

Strategies

In 1989 privately held ESRI of Redlands, Calif., overtook Intergraph to become the market leader in GIS software. While particularly strong in the municipal government market, the 20-year-old company's applications are sold for use in some 15 vertical niches including electrical utilities, oil and gas exploration and forestry.

"We realized between 30% and 60% [annual] growth during the last seven years," says ESRI president Jack Dangermond. Annual sales are about \$55 million and Dangermond expects revenue growth of about 40% this year.

Although Intergraph lost the No. 1 position in GIS software to ESRI, the Huntsville, Ala., workstation vendor remains far and away the dominant supplier of combined GIS hard-



ware and software. Daratech estimates that in 1989 Intergraph held 45.7% of the \$621 million market for GIS hardware, software and service. Gerull estimates that about one-third of Intergraph's sales are GIS- and mapping-related, with about 13% to 14% of that from software.

Intergraph markets the MicroStation GIS line of products, the Tigris image processing program for modeling and analyzing topological data, and the IMAP DataServer for storing and managing large amounts of geographic information.

Computervision was recently organized into four business units with one unit devoted to the GIS market. GIS currently accounts for only about \$22 million to \$23 million of Computervision's sales, according to Fisch. But at a recent Daratech strategy seminar, Computervision president Robert A. Fischer said he expects GIS sales to grow 300% this year.

Computervision sells mapping and site planning applications as part of its CADDs software line. In January the company acquired System 9, a database and three-dimensional geographic information analysis program which Computervision jointly developed with Wild Leitz Group, a Switzerland-based optical equipment manufacturer.

Unlike developers that originally ported their software to mainframes and minicomputers, such vendors as Tydac Technologies Inc. of Ottawa,

MapInfo Corp. in Troy, N.Y., and Strategic Mapping Inc., San Jose, have ported their software to personal computers in a bid to capitalize on the increased power offered by the latest generation of PCs and the growing need for GIS products among non-technical users.

With sales in the range of \$7.5 million, Tydac holds 3.7% of the worldwide GIS software market, according to Daratech. Tydac's SPANS (SPatial ANalysis System) program, which runs under DOS, OS/2 and IBM's AIX version of Unix, is used to access and analyze information stored in larger GIS databases.

IBM's intentions

In 1988 IBM signaled its intention to become a player in the GIS market and struck marketing agreements with a number of GIS software vendors, including ESRI and GeoVision Corp. of Ottawa. Last October IBM acquired an equity interest in Geographic Systems Corp., a Green Bay, Wis.-based supplier of GIS software and services for utility companies and municipalities. At IBM's introduction of its RS/6000 workstation in February, a half dozen GIS software programs were among the applications listed as available for the new line of workstations.

Bringing all this technology together and linking it to other applications and databases is the major task currently facing the major players in the GIS market. "Integration is the major trend right now," says Douglas Gerull, an Intergraph vice president who oversees that company's GIS, mapping and energy product lines. "It's not the same as desktop publishing."

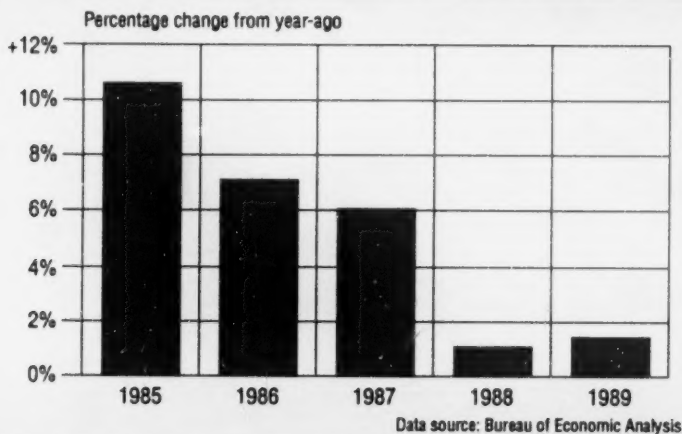
Daratech's Brown notes that because defense and intelligence applications account for many GIS sales, cuts in the U.S. defense budget could slow market growth. But Computervision's Fisch is hoping that any "peace dividend" is spent for environmental protection and other GIS applications.

One certainty about the GIS market is that it will never be boring. Noting that Tydac's products have been used to track oil spills and locust migrations, president Giulio Maffini says: "It's a very interesting business to be in; you're always encountering some new discipline that you haven't run into before." □

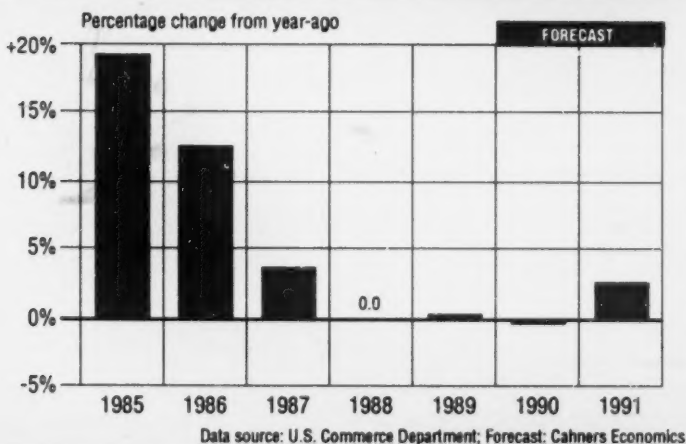
BUSINESS BAROMETER

FORECASTS FOR ELECTRONICS, COMPUTERS AND SYSTEMS

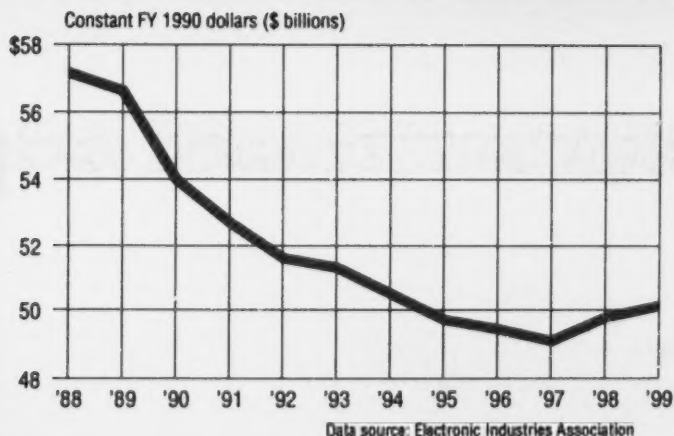
Growth in U.S. defense purchases weakens...



...while shipments of defense electronics slow...



...and electronic content slips



Defense electronics weathers the slowdown

In the last decade defense spending grew at a compounded average annual growth rate of 4.6% after adjusting for inflation. The growing federal budget deficit and easing tensions in Eastern Europe are causing growth in military spending to soften. According to the Department of Defense (DOD), budget authority inched-up a meager 0.2% from \$290.8 billion in fiscal 1989 to \$291.4 billion in 1990. In 1991, the defense budget is expected to reach \$295.1 billion.

Overall growth in national defense purchases rose 1.4% to \$302.3 billion in 1989. After adjusting for inflation, national defense purchases actually fell 2% last year. Despite the scaling back of defense spending, electronics purchases have fared slightly better than other areas. Purchases of defense electronics grew 5.4% for all of 1989, while purchases of aircraft and military equipment declined 9% and 1.3%, respectively.

U.S. production of all defense and space equipment dropped 3.3% in 1989, the second annual back-to-back decline since the 1974-75 period. Cahners Economics estimates that output levels of defense and space equipment will continue to weaken, dropping 4.8% in 1990 and 2.9% in 1991. Likewise, shipments of defense electronics equipment (radar, sonar, navigation equipment and aircraft electronics) rose an anemic 0.1% to \$49.4 billion in 1989. Shipments of defense electronics will continue to shrink this year, declining 0.5% for all of 1990. But by the end of next year shipments will strengthen 2.5%.

Although modernization and upgrading of weapons and space communication equipment is considered a top priority of the DOD, it is likely that the defense electronics market will feel a pinch the next few years due to overall DOD budget cutting. Nonetheless, the electronics market will weather the reduction in better shape than some other defense sectors. The Electronic Industries Association estimates that the electronic content of defense procurement: research, development, test and evaluation, and operations and maintenance will amount to \$54 billion in fiscal 1990, stumble to a low point of \$49.1 billion in 1997, and rise again to \$50.2 billion in 1999 (constant 1990 dollars).

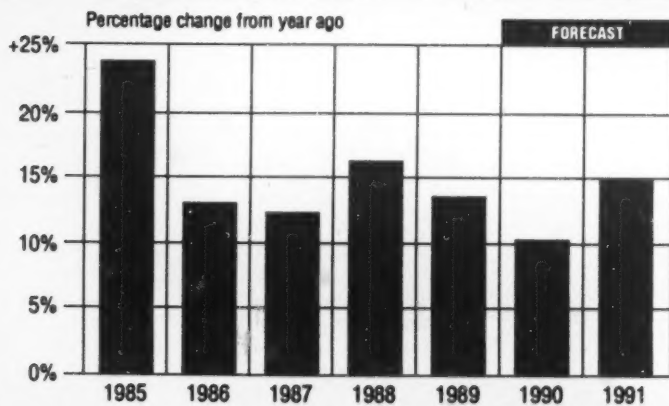
JULIE HANDELMAN, Cahners Economics

For more information about Cahners Economics forecasts and market reports, contact Dan Buchan, Cahners Economics, Cahners Publishing Co., 275 Washington St., Newton, Mass. 02158-1630 or call 617-558-4758.

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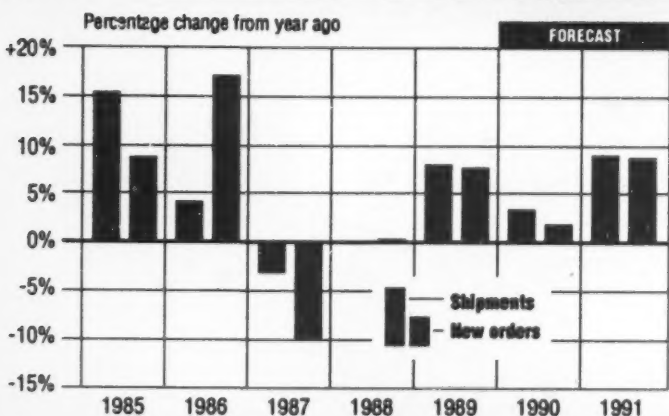
FORECASTS FOR ELECTRONICS, COMPUTERS AND SYSTEMS

Consumer electronics spending slows in 1990



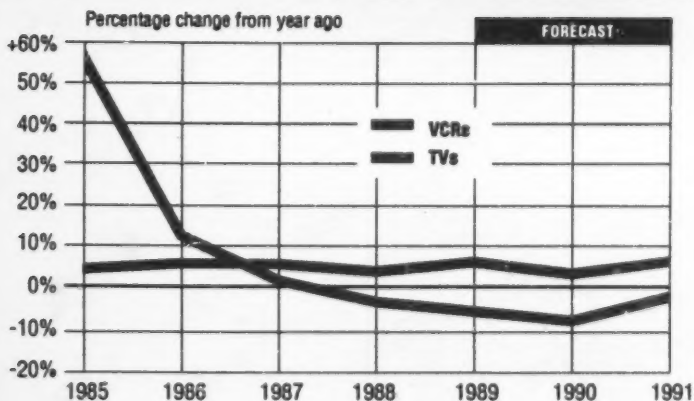
Data source: U.S. Department of Commerce; Forecast: Cahners Economics

TV & radio shipments and new orders



Data source: U.S. Department of Commerce; Forecast: Cahners Economics

Color TV and VCR sales



Data source: Electronic Industry Association; Forecast: Cahners Economics

Consumer electronics sales growth is slowing

A weak fourth-quarter 1989, combined with an uneasiness in the financial markets, has brought home the current fragility of the economy. However, economic signals commonly contradict each other during transitional periods. Despite a few more twists and turns in early 1990, Cahners Economics expects the economy to stabilize later this year.

The U.S. economy squeaked out some minor inflation-adjusted annualized growth in the fourth quarter of 1989. Although this weak showing was anticipated, it is unfortunate it occurred while financial markets were unsteady. Higher interest rates curbed consumer spending on big-ticket items such as homes and automobiles.

What does this mean for the consumer electronics industry? Personal consumption expenditures for TV and radio equipment rose 13.5% to \$71 billion in 1989 compared with year-ago figures. Because lower interest rates encourage spending for more expensive products, purchases for TV and radio equipment are expected to rise 10% this year. But with a healthier economy expected next year expect purchases to rise 14.8% in 1991.

While most other electronic industries experienced sluggish growth last year, the consumer electronics industry flourished. U.S. factory shipments of TV and radio equipment swelled 8.1% to \$12.4 billion in 1989. But demand for many consumer electronics products will not be as strong this year as a sluggish economy continues. Shipments growth of TV and radio equipment is expected to peter out this year, ending 1990 with only a 3.5% gain. Like shipments, new orders of TV and radio equipment ended 1989 with 8.1% growth. However, growth in orders will slide this year, inching-up a meager 2%. As the economy strengthens next year, Cahners Economics expects both shipments and new orders to rise a healthy 9%.

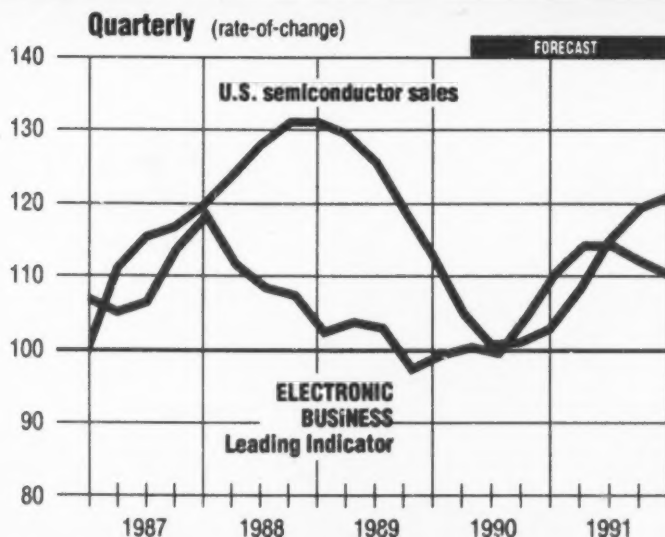
According to the Electronic Industries Association, 21.7 million color television sets were sold to dealers in the United States in 1989, 7.4% higher than the 1988 level. Cahners Economics expects color TV sales to increase 4.6% this year and 7.6% in 1991. Conversely, VCR sales declined 5.8% last year and are forecast to diminish 8.4% this year. The popularity of the VCR market reached its peak in the early 1980s. Because household ownership of VCRs has reached nearly 65%, demand has weakened. VCR sales are expected to drop an additional 2.2% in 1991.

JULIE HANDELMAN, Cahners Economics

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FORECASTS FOR ELECTRONICS, COMPUTERS AND SYSTEMS

ELECTRONIC BUSINESS Leading Indicator



SPECIAL OFFER: A detailed 12-page background paper is available on the ELECTRONIC BUSINESS leading indicator. To obtain a complimentary copy, please contact Linda Spiller at Cahners Publishing Co., 275 Washington St., Newton, Mass. 02158-1630 USA, telephone (617) 558-4397, fax (617) 558-4402



As expected, the ELECTRONIC BUSINESS Leading Indicator appears to be leveling off in the first few months of 1990. With partial data reported for February and March 1990, the leading indicator has dipped to 100.8 and 98.5, respectively. This plateau will remain for the first half of this year, but the indicator is expected to inch upward thereafter. For electronic component and equipment markets, this lack of an immediate strong signal from leading indicators could lead to some confusion among company planners.

Source: Cahners Economics

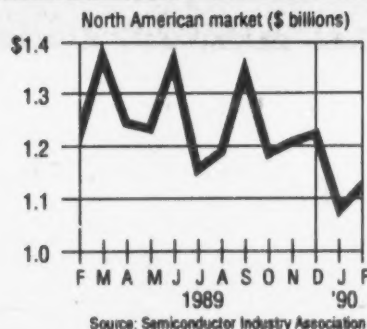
Electronics industry indicators this month

	Latest month	Previous month	Year ago	1989 average
ELECTRONIC BUSINESS Leading Indicator (rate-of-change, Feb.)	100.8	101.6	102.8	100.9
U.S. semiconductor bookings (\$ millions, 3-month average, Feb.)	\$1,202	\$1,214	\$1,266	\$1,204
Weekly hours of semiconductor production workers (monthly average, Jan.)	40.1	41.7	40.0	40.1
Electronic components leadtime index (1977 = 100, March)	84.8	94.6	117.7	102.5
S&P's semiconductor stock price index (1970 = 10, monthly average, Feb.)	61.9	60.5	51.0	54.7
Change in electronic components inventories (\$ millions, SA, Jan.)	\$21	-\$187	-\$50	-\$4.4
Contracts and orders for plant and equipment (\$ billions, SA, Jan.)	\$43.0	\$48.8	\$45.0	\$43.4

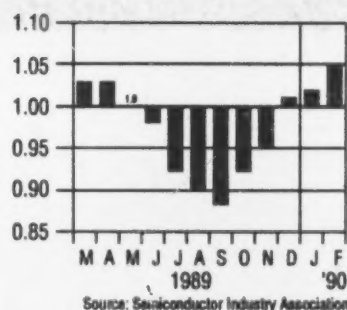
SA = seasonally adjusted, all other data is not seasonally adjusted

Sources: Semiconductor Industry Association, U.S. Bureau of Labor Statistics, Electronics Purchasing magazine, Standard & Poor's, U.S. Department of Commerce, U.S. Bureau of Economic Analysis

Semiconductor sales



Semiconductor book-to-bill ratio



Component inventory-to-shipments

